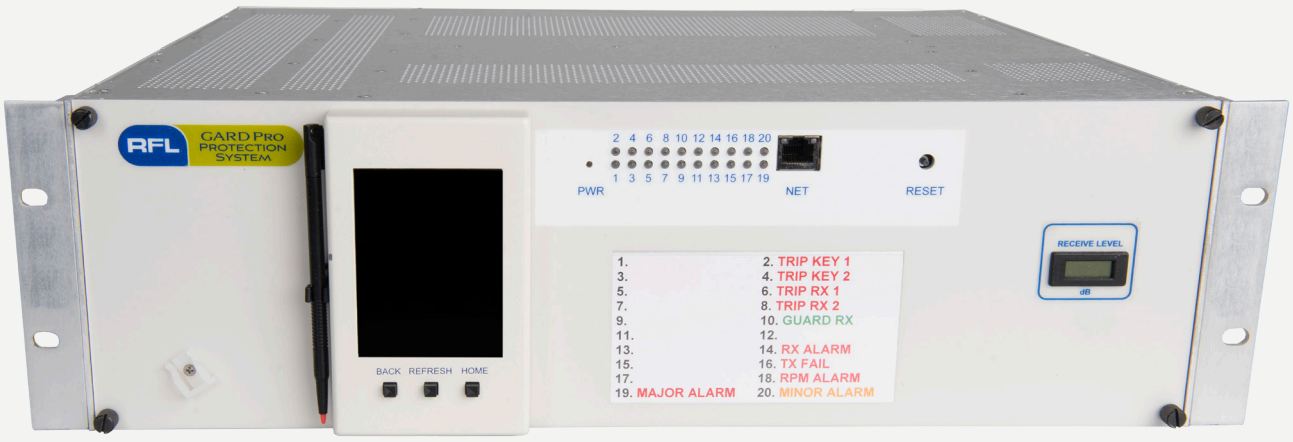
RFL

SOLUTIONS FOR AN EVOLVING WORLD

GARD Pro

Programmable Single Function PLC



HUBBELL

Your world is changing and so are we.

At RFL, we know your needs change much faster than your infrastructure. Our comprehensive line of solutions meets you wherever you are to help you bridge the gap from yesterday to tomorrow.

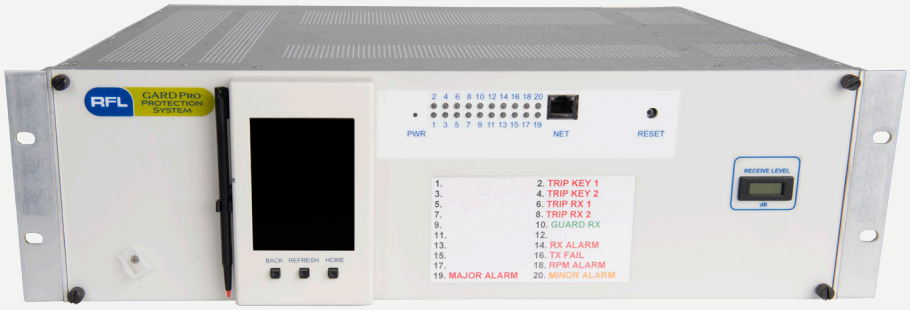
We aren't just engineering products. We are continuously innovating to give legacy equipment the advantage of today's technologies. Our highly adaptable solutions offer more features for more flexibility and a custom fit for your specific needs.

When we deliver, we also deliver our reputation. So when you open that box, you're opening a custom-engineered solution, factory-tested and ready for deployment.

And as long as you own that equipment, you own the attention of RFL. We see you as our partner and we want to ensure that our solution is working for you – now and over the long haul. RFL – delivering solutions that work. Period.

GARD Pro

Programmable Single Function PLC



System Features

New intuitive web browser user interface for setting and diagnostics; no proprietary application program required

Fourth-generation RFL PLC system

Remote access via Ethernet, RS485

New Front-panel Touch-Screen Display for Calibration, Status, SOEs, and Testing

Intuitive Alarm Reporting

User-defined logic and alarms for your specific applications

Optional built-in GPS receiver

New DNP3, Level 2 compliant

SNMP Trap and Get Support

Full system redundancy option available

Facilitates NERC-CIP Compliance

Easily save/compare configuration files

10 Year Warranty

Single Function PLC Features

One product for all ON/OFF and FSK (2F/3F) PLC applications

Up to four ON/OFF or FSK modules can be supplied in one 6U chassis

Front-Panel CLI meter standard

One output filter for all frequencies, 30-500kHz

Built-in skewed hybrid available

One-click receiver calibration

Integrated Reflected Power measurement

Full system redundancy option

10W, 50W, and 100W Power Options

Built-in Checkback with remote-initiate and hard carrier request

Backward-compatible checkback (all 4 previous generations of RFL PLC)

Complies to latest ANSI C93.5-1997 Single Function PLC Standard

Web Browser Interface

The GARD Pro System is designed with ease-of-use in mind. While high functionality and great detail is provided, the GARD Pro User Interface makes interaction with the device highly intuitive and handling greatly simplified.

All interaction with the GARD Pro System is made by the use of a standard web browser. The web pages reside in the device; no special application software is required on the PC.

A PC is connected to the front Ethernet TCP/IP port with a standard Ethernet cable. It is fast and simple to view device status, access diagnostic and test functions and to change settings. Emulating the operations of a standard web site, navigation is intuitive and eliminates the need to study written instructions. If needed, the instruction manual, that also resides in the device, is simply accessed by the HELP function.

For off-line preparation of settings and configuration files, a small application program “emulating” a GARD Pro System can reside on a PC or local server. Archiving and documentation of settings and configuration is made simple as these are stored in standard text files.

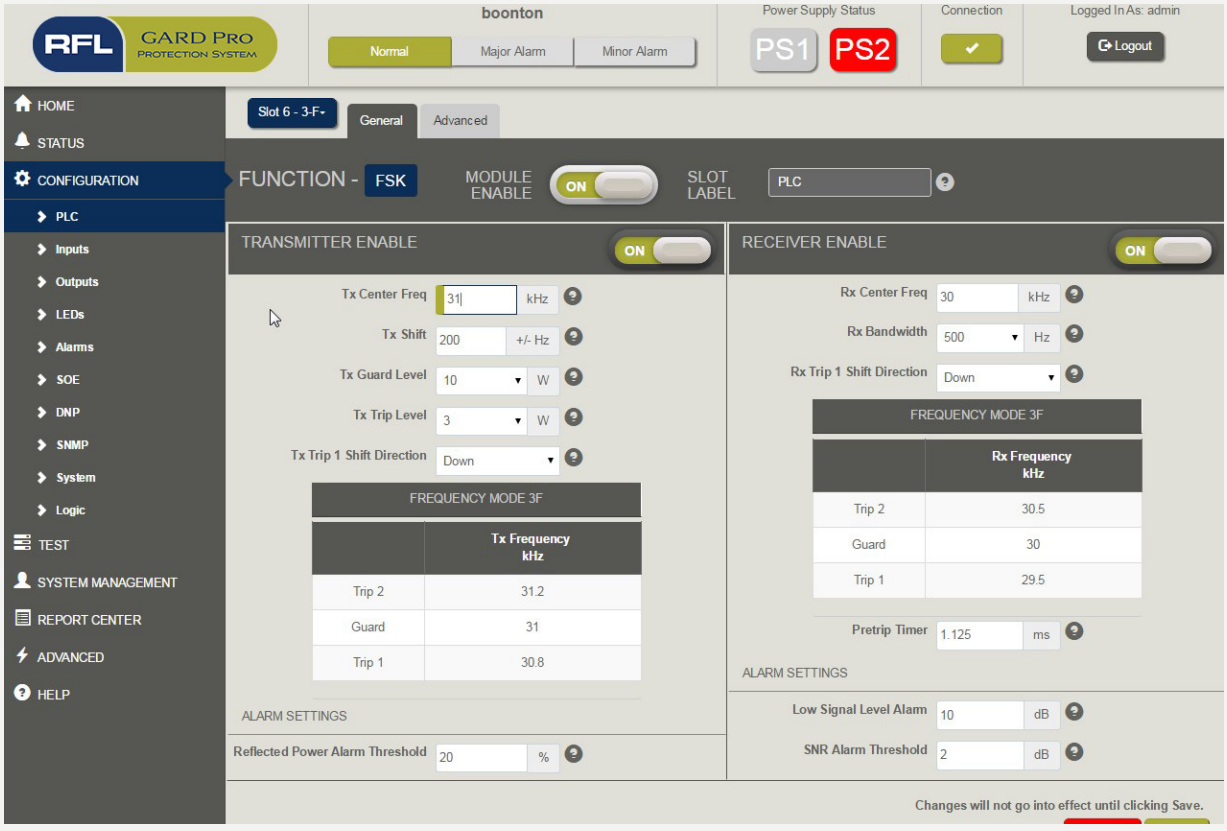


Figure 1. GARD Pro User Interface

System Description

The GARD Pro Single Function PLC channel is a product that can be programmed as Frequency-Shift Keyed (FSK) power line carrier system or as an amplitude-modulated ON/OFF powerline carrier terminal.

The unit is designed for pilot protection relaying applications, requiring high-speed reliable communications. The GARD Pro can be programmed for On/Off type directional comparison blocking (DCB), direct transfer trip, (DTT) Unblocking (DCU), permissive (PTT), or either single- or dual-phase comparison applications.

The extensive sequence of events and diagnostic features provide information for the GARD Pro and integrated PLC modules.The chassis is available in both a 3U version which can support one PLC system, or a 6U version which can support up to four PLC systems.

The unit is available with front panel direct reading (in dB) digital meter to indicate receive signal strength. Each unit also comes with an external carrier level indicator output for use with external measuring devices such as a panel meter or an analog RTU input.

On/Off Operation

Description

On/Off Powerline Carrier is normally used in a "Blocking" type protection application. In this application the transmitter is normally off, and is turned on by a protective device. The blocking signal is sent to a remote station, via the transmission line, to prevent undesirable tripping for circuits that are not affected by the system fault. The Blocking signal needs to be sent, and received with a minimum of delay to prevent tripping out healthy circuits, and causing unnecessary system disturbances. On/Off Powerline Carrier applications, are almost always bi-directional, and send, and receive the same RF frequency at both terminals.

Transmitter

Frequency programmable: Frequency programmable from 30 to 500 kHz in 125 Hz increments, without hardware changes.

Output Power: Programmable for 1 watt, 3 watt, or 10 watt levels. Output power is displayed on optional front PDA and is remotely accessible. The unit is available with 50W and 100W options in external 3RU chassis.

Output Impedance: 50-Ohm standard
75-Ohm available

Frequency Stability: +/- 10 Hz

External Keying Inputs: Carrier Start, Stop, Reserve Signal Key, and Check Back Test Initiate. Customized logic can be programmed for all inputs. All inputs programmable active high or low to operate at the following nominal voltage levels: 24 Vdc, 48 Vdc, 125 Vdc, 250 Vdc. Active inputs are recorded in SOE files and their status displayed on the optional front TSD.

Receiver

Frequency programmable: Programmable from 30 to 500 kHz in 125 Hz increments, without hardware changes.

Receiver Calibration: One-click commissioning. The receiver sensitivity will self adjust to the actual receive level.

Receiver Input Impedance: Terminated: 50-Ohm or 75-Ohm. Unterminated: > 30-kOhm.

Dynamic Range: >40dB

Receiver Bandwidth, Channel Spacing and Channel Delay Times: Receiver bandwidth is user selectable from the following table, without hardware changes. The channel times are inclusive of the GARD Pro System.

Nominal Bandwidth	*Total Channel Delay Time*	*Channel Spacing*
500 Hz	5 ms	1 kHz
1000 Hz	3 ms	2 kHz
1500 Hz	1.5 ms	3 kHz

Receiver Outputs: The receiver can be provided with the following standard outputs; or programmed for specific applications:

- Block received
- Transmitter Fail / Hardware Alarm
- Checkback fail alarm
- Checkback test in progress
- Checkback initiate status
- High percent reflected power alarm
- Logic alarm

Automatic Checkback Operation: The PLC system is supplied with an internal automatic carrier checkback program. The checkback code structure, and programming is compatible with the existing RFL GARD 8000, 9785, 6785P, and 6720P checkback systems. The checkback can also be manually initiated from either end.

This system consists of two modes, normal and hard carrier. In normal mode, a code is on-off modulated onto the powerline and a response code is returned at full or reduced power by the receiving station. In hard carrier, instead of a response code, the receiving station responds by turning on its carrier at full or reduced power for a programmed period of time.

FSK Operation

Description

Frequency shift power line carrier is normally used in a “Unblocking” or “Permissive” type protection applications. In these applications the transmitter is continuously sending a “Guard” signal via the transmission line to the remote terminal. Reception of the guard signal provides both continuous channel, and equipment monitoring. The transmitter is keyed to the Unblock or Trip frequency by a protective device. The trip signal is sent to a remote station, via the transmission line, to enable tripping for circuits that are affected by the system fault.

Transmitter

Frequency programmable: Frequency programmable for either 2F, or 3F operation, from 30 to 500 kHz in 125 Hz increments, without hardware changes. Output frequency settings are available on the optional front-panel TSD.

Frequency Shift : Standard frequency shifts of +/- 100 Hz +/- 250 Hz, and +/- 500 Hz are available.

Output Power: User programmable for the following power output levels:

1W guard /1W trip
1W guard /10W trip
3W guard /10W trip
10W guard /10W trip
Optional 50W guard /50W trip available
Optional 100W guard /100W trip available

Output Impedance: 50 Ohms standard
75 Ohms available

Frequency Stability: +/- 10 Hz

Trans Hybrid Loss Measured

The trans-hybrid attenuation value is also available to the system. The amount of the transmitter leaking back into the receiver will be measured. This attenuation includes the effect of any receive filter. This feature eliminates the need for frequency selective voltmeters to perform routine carrier maintenance testing.

Receiver

Frequency programmable: Programmable from 30 to 500 kHz. in 125 Hz increments, without hardware changes.

Receiver Level: The receiver sensitivity self adjusts to the incoming signal strength. The actual signal level is available for display on the optional front-panel TSD, remotely via TCP/IP or RS-485 interface or on a local laptop.

Receiver Sensitivity: Minimum = 5 mVrms,
Maximum = >25 Vrms

Receiver Input Impedance: Terminated: 50-Ohm or 75-Ohm. Unterminated: > 30-kOhm.

Dynamic Range: >40dB

Receiver Bandwidth, Channel Spacing and Channel Delay Times: Receiver bandwidth is user selectable from the following table, without hardware changes. The channel times are inclusive of the GARD Pro system.

Nominal Bandwidth	*Frequency Shift*	*Total Channel Delay Time*	*Unidirectional Channel Spacing*	*Bidirectional Channel Spacing*
200 Hz	+/- 100 Hz	13 ms	500 Hz	1000 Hz
500 Hz	+/- 250 Hz	8 ms	1250 Hz	2500 Hz
1000 Hz	+/- 500 Hz	6 ms	2500 Hz	5000 Hz

Transmit and Receive Levels Measured

The Transmit and Receive Levels are measured and can be accessed remotely. If the receive level drops below a preset value an alarm will activate.

Reflected Power Measurement

The power reflected due to mismatch of the power line coupling equipment is measured every second and available when requested. There is also a user-programmable reflected power alarm level.

Diagnostics and Testing

Diagnostic information is available and easily accessible with the GARD Pro Single Function PLC unit. RFL's diagnostic package takes the guesswork out of power system fault analysis and evaluating communications system performance during the fault-clearing process. The GARD Pro Single Function PLC provides the following standard features:

Two ethernet TCP/IP ports for local and remote access
2,048 Sequence-of-events records
Remote access to transmit, receive, & reflected power levels
Internal real-time system clock
Optional built-in GPS receiver
IRIG-B Clock sync input
Current status of all system parameters
Checkback testing either locally or remotely initiated
Automatic checkback

Sequence of Events

The figure below shows the Sequence of Events staus page. There are several sorting options available for the records, either by label or by date. The date range or 'window' can also be dynamically changed via a slider bar.

The SOE log also stores detailed information about the state of the unit during each SOE event. All SOE triggers and logic bits can be viewed for a given event. Events can be viewed incrementally by stepping through the intuitive user interface.

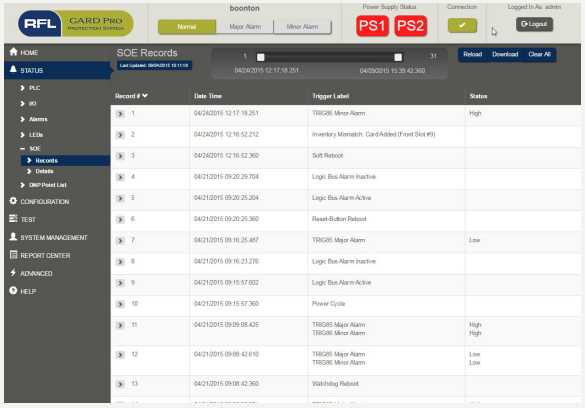


Figure 2. Sequence of Events Log

User Programmable Logic Functions

Change timer values, logic states and logic functions without ever removing a module or opening the chassis.

User Programmable Inputs and Outputs

The smaller 3U version of the GARD Pro, when configured with the single Function PLC module, has two I/O slots available. Each slot can accept up to two six-channel input / output modules. All logic mapping to the inputs and outputs is fully programmable to meet specific customer requirements.

Create your own alarm conditions

The GARD Pro Single Function PLC unit can be programmed to any alarm configuration desired using the outputs on the I/O modules.

Programming

The GARD Pro Single Function PLC unit uses a standard web browser (like Internet Explorer). All programming levels available over the TCP/IP interface are password-protected. There are also several options for setting priveleges - port-specific read-only access can be configured for accounts as needed.

Every GARD Pro Single Function PLC unit is supplied pre-programmed with either default operating logic or custom logic. It should be noted that it is standard practice for RFL to provide system programming with every unit at no charge.

Carrier Level Indicator

Display Front panel digital (in dB)

Range ±10 dB

External Meter Output 0-5 V, 0-1 mA, 0-100 mA

Real Time Clock

IRIG-B

The GARD Pro Single Function PLC unit accepts the IRIG-B Standard Time Code on a 1kHz modulated or unmodulated carrier. Nominal signal levels are 3.3 volts peak-to-peak (± 0.5v) for a logic "1" and 1 volt peak-to-peak (± 0.2v) for a logic "0". The IRIG-B input presents a 3.7k ohm impedance and is transformer isolated. An optional integrated GPS receiver is available.

Resolution 1 ms

Accuracy

Free Running: Within 1 minute per month
Under IRIG-B Control ±1msecs

Reset

Manual or by IRIG-B code

Remote Access

Events Storage

The Sequence of Events Recorder on the main controller module can store up to 2,048 events. After this limit is reached, older events are overwritten. The Events Log keeps a running tally of the number of times each function, input, output and alarm is active along with the time and date the event occurred. Up to 1,000,000 counts can be stored for each item.

Ethernet TCP/IP Port

Two ethernet TCP/IP ports, located on the front and rear of the chassis, for remote interrogation.

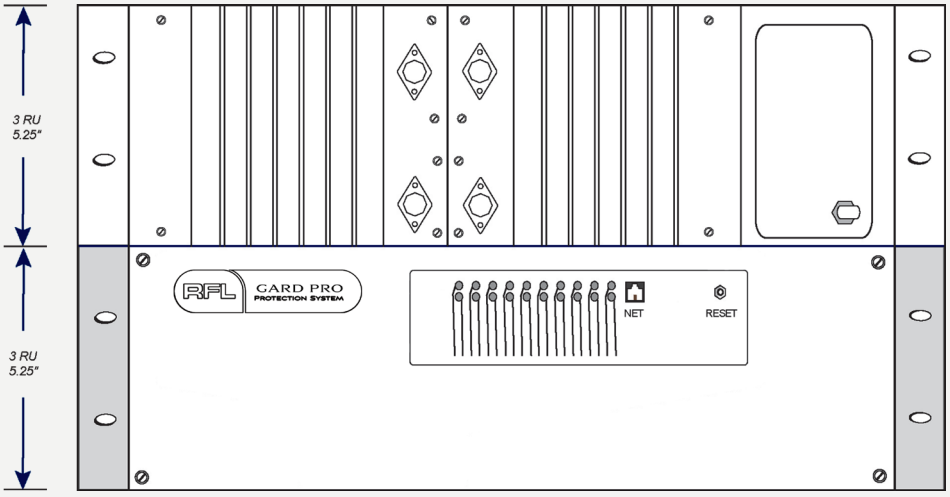


Figure 3. GARD Pro 50 Watt Configuration

The GARD Pro Single Function PLC can be configured for either 10, 50 or 100 Watt RF power outputs. The RFL model 9508 RF power amplifier is rated for 50 Watt PEP and is the standard amplifier used for single sideband applications. Two amplifiers are required for 100 Watt applications.

General Specifications

Displayed Level Accuracy

The levels displayed on the front panel and through remote access will be within 1 dB of the actual values.

Pre-Trip Timer

Adjustable in 0.5 ms steps

Trip Hold Timer

Adjustable in 0.5 ms steps

Command Extend Timer

Adjustable in 0.5 ms steps

Non-Volatile Storage

All parameters relating to system operation and SOE are stored in non-volatile RAM.

Specifications are subject to change without notice

RFI Susceptibility
ANSI C37.90.2 (35 Volts/Meter)
EN 60255-22-3 (RFI Class III)

Interface Dielectric Strength
All contact inputs, solid-state outputs, power supply inputs and relay outputs meet the following specifications:

ANSI C37.90-1989 (Dielectric)
ANSI C37.90.1-2002 (SWC and Fast Transient)
EN 60255-5 (1500 Vrms Breakdown Voltage and Impulse Withstand)
EN 60255-22-1 (SWC Class III)
EN 60255-22-2 (ESD Class III)
EN 60255-22-4 (Fast-Transient Class III)
EN 60834-1

Input Power Requirements (EN 60834-1)

24V	Rated	Vdc
	Range	19-29 Vdc
	Burden	<100W
48/125V	Rated	48/125 Vdc or 120 Vac
	Range	38-150 Vdc or 96-132 Vac
	Burden	<100W
250V	Rated	250 Vdc or 220 Vac
	Range	200-300 Vdc or 200-240 Vac
	Burden	<100W

Power Supply
A single or redundant power supply can be provided depending on the reliability of the application. For example a DTT application for a higher voltage level line may demand the dependability of a redundant power supply. When a redundant supply is used, only one supply carries the load. The GARD Pro Power Supply is provided with Form C alarm contacts for power supply failure and system failure alarm.

Temperature
Operating: -20° C to +75° C (-4° F to + 167° F)
Storage: -40° C to +85° C (-40° F to +185° F)

Relative Humidity
Up to 95 percent at +40° C (+104° F), non-condensing

Warranty Statement
RFL's standard warranty for the Single Function PLC unit is 10 years from date of delivery for replacement or repair of any part which fails during normal operation or service.

Ordering Information
Contact RFL or use GARD Pro configurator available on RFL website (www.rflelect.com).

Front Panel LEDs

Two rows of ten multi-colored LEDs provide basic event information. The LED operation is fully configurable and labels can be changed to suit the application. Custom configuration and labeling can be factory-made by RFL without extra charge. Any field modifications required are simply made by use of the browser interface.

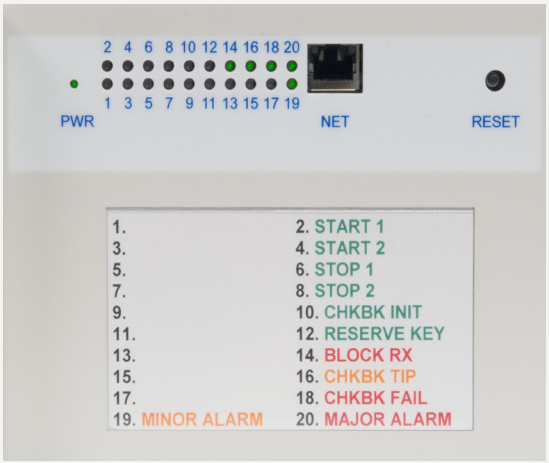


Figure 4. GARD Pro Front Panel LEDs (3U)

Front Panel Display

An optional touch screen display (TSD) is available for checking receive levels, alarm status, SOE and performing commissioning functions such as receiver calibration. User-programmable buttons are provided for unique customer requirements, for things such as breaker control or cut-in/cut-out switches, as well as test functions like checkback.

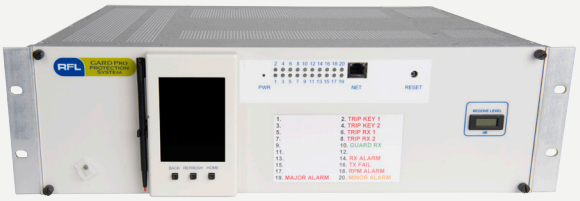


Figure 5. GARD Pro 3U Front Panel

Specifications are subject to change without notice

Inputs & Outputs

The GARD Pro System is configured with a selectable number of input and output modules on the rear of the chassis.

Solid-state outputs, relay outputs and inputs are mounted in sets of 6, with up to 2 sets on each board, occupying 1 slot. The following combinations are available:

6 inputs/6 inputs
6 inputs/6 relay outputs
6 inputs/6 solid state outputs
6 solid state outputs/6 solid state outputs
6 solid state outputs/6 relay outputs
6 relay outputs/6 relay outputs

All relay output contacts are Form A (NO) or Form B (NC), jumper selectable.

A simple setting provides inversion for each input and output. Each input and output has a timer associated with it that has settings for both pick-up delay (input debounce, output security) and drop-out delay (pulse-stretch).

Optically Isolated Inputs

Quantity: 6 per module

Input Voltage Jumper Selectable: 24/48/125/250 Vdc
Operation Range:

24 Volts:	19 to 36 Vdc, Nominal Input
48 Volts:	37 to 68 Vdc
125 Volts:	94 to 150 Vdc
250 Volts:	189 to 300 Vdc

Input Current: 1.5 mA minimum

Minimum Pulse Width:
0.03 ms, additional debounce time set in the logic

Solid-State Outputs

Quantity: 6 per module
Output Current:
Maximum 1 A continuous, 2 A for 1 minute, or 10 A for 100 msec
Open-Circuit Voltage: 300 Vdc maximum
Pick-up Time: 0 msec

Relay Output

Quantity: 6 per module
Relay Pick-up Time: 4 msec
Output Current Rating: 6 A continuous
Surge: 30 A for 200 msec

Alarm Relays (Major / Minor)

Quantity: 2
Contacts: SPDT (Form C)
Output Current: 100 mA 300 Vdc resistive load

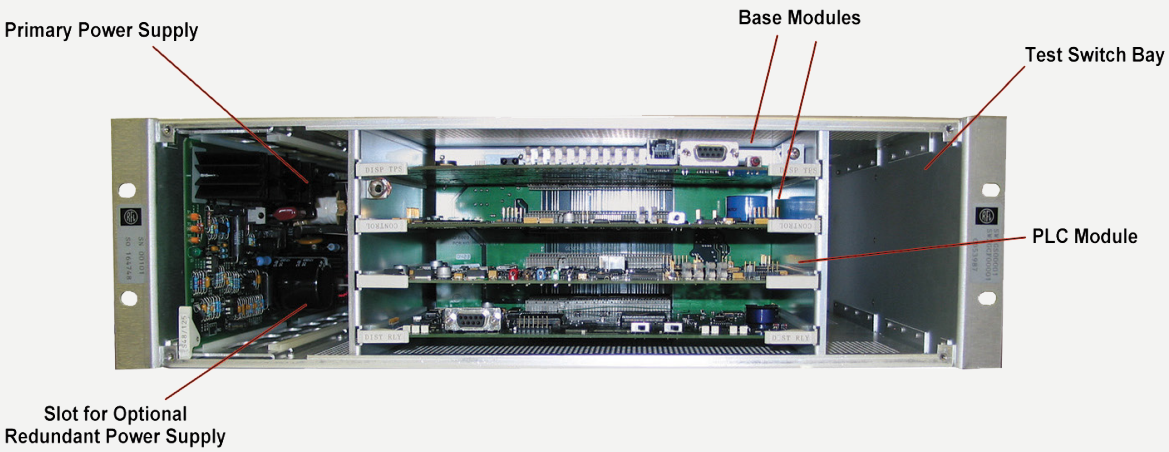


Figure 6. Front View 3U GARD Pro with panel removed

Examples of GARD Pro System Configurations

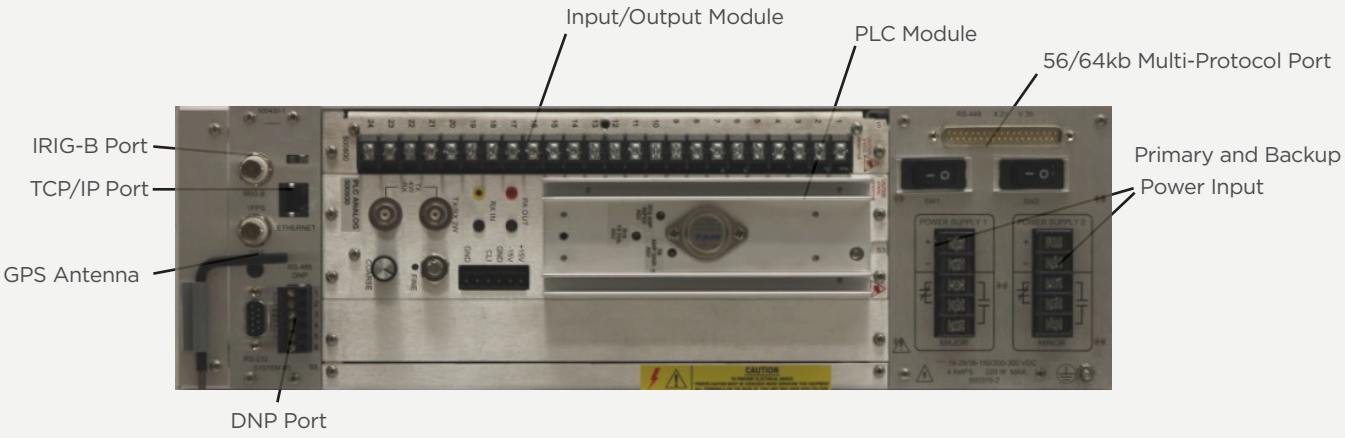


Figure 7. Rear View 3U GARD Pro with PLC Module and Input/Output Module

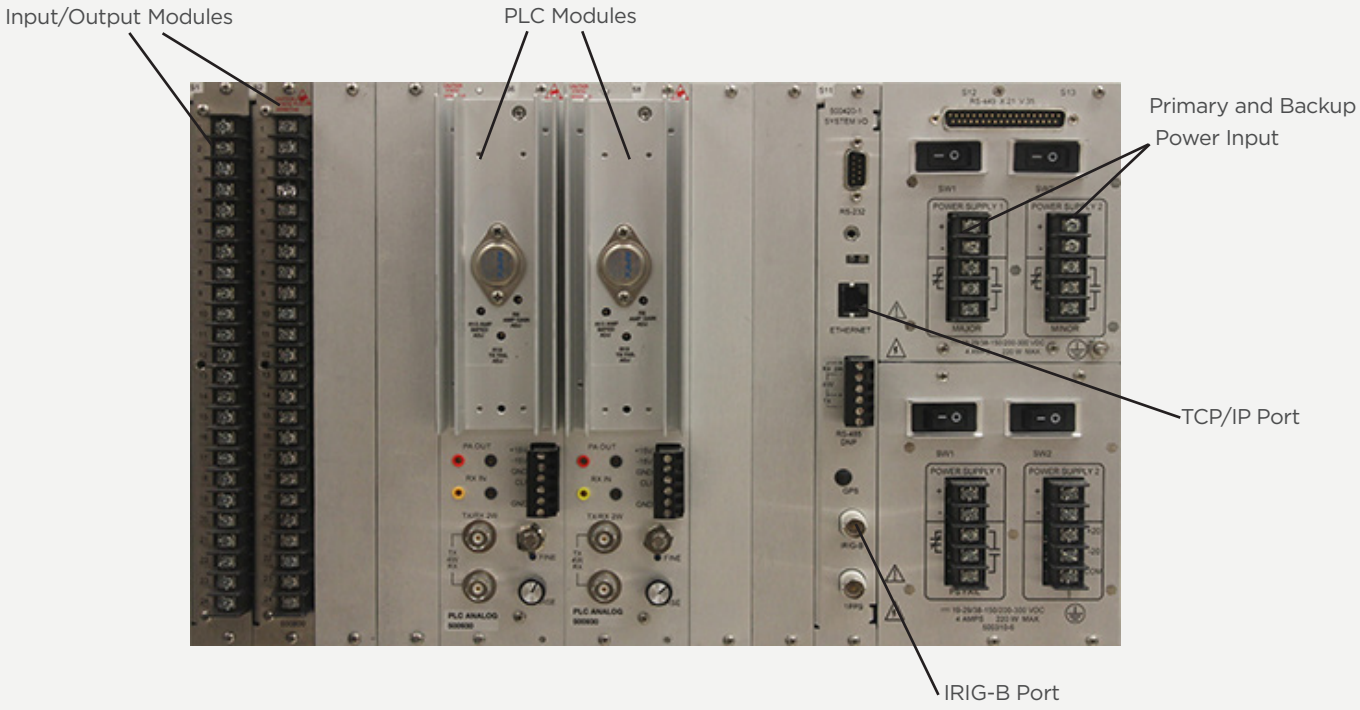


Figure 8. Rear View 6U GARD Pro with (2) PLC Modules and Input/Output Modules

Dimensions

GARD Pro
Single Function PLC
3U System Dimensions

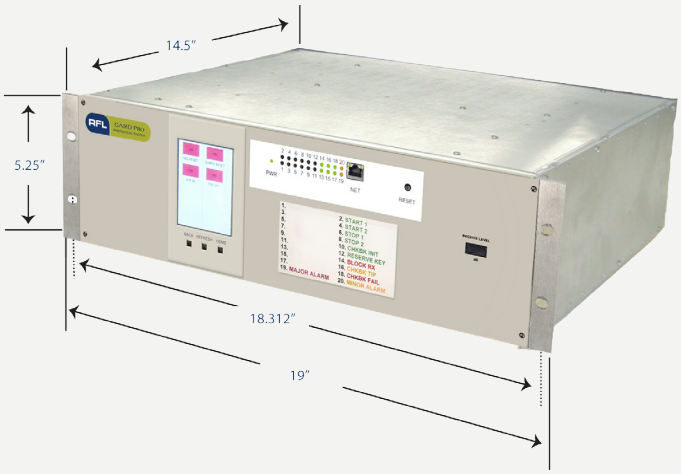


Figure 9. Rack or Cabinet Mounting (3U)

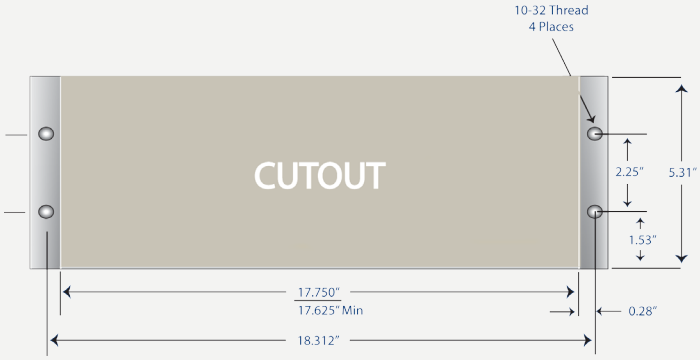


Figure 10. Panel Mounting (3U)

6U System Dimensions

Figure 11. Rack or cabinet Mounting (6U)

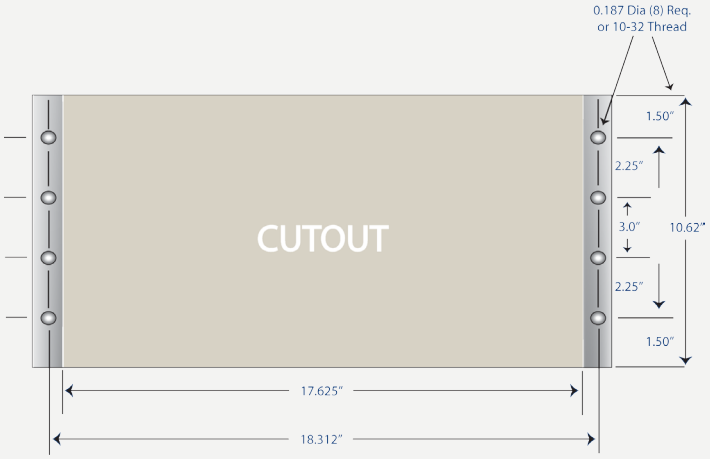


Figure 12. Panel Mounting (6U)

Notes

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